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A REVISION OF THE *ALLIUM FIMBRIATUM*
(ALLIACEAE) COMPLEX

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ABSTRACT

Allium fimbriatum in California and northern Baja California causes frequent difficulty in identification. The species, as defined by Ownbey, comprises nine varieties and is characterized by great morphologic diversity. No single character or suite of characters separates this species from others in the *A. sanbornii* alliance. This investigation was undertaken to survey the large number of herbarium specimens that have accumulated since Ownbey's study and to observe all of the taxa in the field or garden, something not accomplished by Ownbey. Orientation of the perianth segments, visible only in living material, along with shape and presence or absence of denticulation, is valuable in distinguishing between taxa. Characters of the ovarian crest processes, including the presence or absence and location of surface ornamentation and the degree to which the margins of the processes are denticulate or fimbriate, are also important. Based on these characters, along with habit, edaphic preference, and geographic distribution, seven species and two varieties are recognized. Of these, *A. abramsii*, *A. denticulatum*, *A. diabolense*, *A. munzii*, *A. parryi*, and *A. sharsmithae* were previously classified by Ownbey as varieties of *A. fimbriatum*. Chromosome numbers (all $n = 7$) are reported for each taxon. Line drawings of representative ovarian crests and perianth segments, a key, and distribution maps of the taxa are presented.

Key words: Alliaceae, *Allium fimbriatum*, taxonomy.

INTRODUCTION

Allium is a difficult genus in western North America; many taxa are rarely collected. Furthermore, characteristics visible in living specimens are often obscured or destroyed by pressing. As has been pointed out in a number of recent papers (McNeal and Ownbey 1982; Mortola and McNeal 1985; Denison and McNeal 1989; McNeal 1992), these factors have combined to cause earlier investigators to overlook critical features and to misinterpret geographic variation in a number of species. This is particularly true of *Allium fimbriatum* S. Wats. which, as circumscribed by Ownbey, consists of nine varieties.

Allium fimbriatum sensu Ownbey was one of a group of North American species referred to the *A. sanbornii* alliance by Ownbey (Saghir et al. 1966). Species in this alliance are characterized by a solitary terete leaf and an ovarian crest formed by six prominent and nearly triangular flattened processes, two near the summit of each of the three ovary lobes. It is the most distinctive of the nine alliances proposed by Ownbey. However, *A. fimbriatum* sensu Ownbey is confusing because no single feature or suite of features serves to define the species nor to separate it from other members of the alliance. This investigation revealed distinct morphological characters among Ownbey's varieties of *A. fimbriatum*, including shape and orientation of the perianth segments, ornamentation on the ovarian crests, and habit, as well as differences in edaphic and geographic distribution. When taken together these differences suggest that seven of Ownbey's varieties are not as closely related to each other nor to *A. fimbriatum* as he believed. These seven

taxa are recognized here as distinct species (*A. abramsii*, *A. denticulatum*, *A. diabolense*, *A. munzii*, *A. parryi*, and *A. sharsmithae*).

Allium fimbriatum was described by Sereno Watson (1879) from a specimen consisting only of flowers and pedicels collected by Palmer along the Mojave River in southern California. In the same paper he also described *A. parryi* from San Bernardino County. Jepson (1922) described two new varieties of *A. fimbriatum*, var. *mohavense* from the Calico Mountains in San Bernardino County and var. *aboriginum* from Lake County and the southern Sierra Nevada. The specimens he cited from the southern Sierra Nevada were a mixture of var. *fimbriatum* and two other taxa that Ownbey later (in Munz and Keck 1959) described as varieties *abramsii* and *denticulatum*. Eastwood (1938) described *A. purdyi*, recognizing that it was related to *A. fimbriatum* and *A. parryi*, but not speculating on these relationships.

When Ownbey revised the group (in Munz and Keck 1959), he reduced *A. parryi* to a variety of *A. fimbriatum*, synonymized var. *aboriginum* with var. *fimbriatum*, and described five additional varieties within *A. fimbriatum*.

A survey of specimens from major American herbaria leads to the conclusion that five of Ownbey's proposed varieties (*A. purdyi*, which was never validly published at the varietal level, and vars. *diabolense*, *munzii*, *mohavense*, and *sharsmithae*) were probably not seen by Ownbey growing under natural conditions or, except for *A. purdyi*, in the greenhouse. My studies of living material, both in the field and under cultivation, and of the much larger number of herbarium specimens now available, have led to this revision of the *A. fimbriatum* complex.

Although they appear in Munz and Keck (1959), Ownbey never validly published his proposed varieties. Valid publication of vars. *abramsii*, *denticulatum*, *diabolense*, *munzii*, and *sharsmithae* was finally accomplished by Traub (1972); the epithets *parryi* and *purdyi* were not validly published until Traub (1967) published them as subspecies of *A. fimbriatum*. These varieties were attributed to Ownbey and Aase in Munz and Keck (1959), presumably because the two authors were planning to publish a treatment of the *A. sanbornii* alliance; they had published an earlier paper on the *A. canadense* alliance (Ownbey and Aase 1955). No such paper was published and all of the specimens I have seen were annotated only by Ownbey. For purposes of attribution therefore, I refer to these as Ownbey ex Traub.

MATERIALS AND METHODS

As part of a revision of *Allium* in California, I studied the specimens of major American and Californian herbaria (CAS, CHSC, CPH, DAV, DS, GH, JEPS, MO, NY, POM, RSA, UC, US, WS). In addition, I made field observations of all but one of the taxa (*A. munzii*) treated in this paper and, where possible, grew them in Stockton, California. The exception, *A. munzii* is a very rare species from an area of southern California that is being rapidly urbanized. Collections of this species were made by Steve Boyd (RSA) from each of the seven known populations, and bulbs of each were grown at Stockton. Chromosome counts of all taxa were made using aceto-orcein squashes of pollen mother cells from fresh flower buds.

RESULTS

In the course of this investigation, all of the taxa treated were collected. However, for *A. munzii* and *A. sharsmithae*, the number of sheets of specimens in herbaria is still less than 30. The field studies and cultivated plants gave ample opportunity to observe such features as condition and length of the leaf at anthesis, orientation and shape of the perianth segments, and degree and type of denticulation of the margins of the crest processes. The results of these observations are found in the taxonomic treatment which follows. The measurements given for each taxon in the taxonomic treatment represent both new specimens collected during the investigation and over 1500 specimens from the herbaria listed above.

Field observation indicates that all taxa in this investigation are well adapted to summer drought and irregular amounts of rainfall from year to year. Flowering seems to be correlated with late autumn and early winter rains. In drought years most plants will produce a leaf but very few flower, in some cases plants will initiate flower buds but these wither prior to anthesis. When rainfall is heavier almost all plants in a population flower successfully.

In all taxa the meiotic chromosome number was found to be $n = 7$, the most common number for North American species (McNeal 1969, Mingrone 1968, Ownbey and Aase 1955). Vouchers for chromosome counts are given in the Appendix.

TAXONOMIC TREATMENT

In the following key, characters are given that will allow the reader to separate members of the *A. sanbornii* alliance from other North American species and to distinguish the other species in the alliance (indicated by brackets) from those treated here as part of the *A. fimbriatum* complex.

1. Leaves 2 or more per scape; if 1, flattened or broadly channeled All North American species except the *A. sanbornii* alliance
1. Leaf solitary, terete *A. sanbornii* alliance
 2. Stigma entire or only microscopically lobed [*A. atrorubens*, *A. monticola*, *A. nevadense*, *A. parishii*, *A. sanbornii* var. *sanbornii*]
 2. Stigma distinctly 3-lobed, the lobes often slender and recurved.
 3. Stamens exerted, or at least equalling the perianth segments [*A. howellii*, *A. sanbornii* var. *congdonii*]
 3. Stamens included.
 4. At least the inner perianth segments denticulate to erose.
 5. Scape 2.5–4.0 dm tall [*A. jepsonii*]
 5. Scape 0.5–2.0 dm tall
 6. Outer bulb coats red-brown; at least the inner perianth segments denticulate.
 7. Perianth segments lanceolate to lance-ovate, acute, usually both whorls denticulate; ovary papillose between the crest processes, margins of the processes entire, emarginate, or minutely papillose 1. *A. denticulatum*
 7. Perianth segments broadly elliptic to ovate, obtuse to blunt or shallowly emarginate, frequently denticulate across the apex; ovary \pm smooth between the crest processes, margins of the processes finely and irregularly dentate 2. *A. munzii*
 6. Outer bulb coats brown to grey; inner perianth segments erose, at least in the proximal half 3. *A. abramsii*

4. Perianth segments entire.
8. Ovarian crest processes entire or notched at the tip, the outer margins sometimes irregular or papillose, but never denticulate, fimbriate, or lacinate.
 9. Perianth segments 10–18 mm long, maroon or dark red-purple.
 10. Bulbs forming 1–2 basal bulblets or threadlike rhizomes which produce a terminal bulblet; perianth maroon, tips of the outer whorl recurved to coiled, the inner spreading to recurved; on soil derived from schist or aplite, Spanish Needle Peak, NE Kern Co. [A. shevockii]
 10. Bulbs lacking both basal bulblets and rhizomes; perianth dark red-purple, segments flaring slightly at the tip; serpentine soils, Mt. Hamilton Range 4. *A. sharsmithae*
 9. Perianth segments 6–10 mm long, white to pink at anthesis, becoming reddish in age.
 11. Perianth segments lanceolate to lance-ovate, entire, acute to attenuate; outer pedicels of the infructescence up to 20 mm long and curved upwards 5. *A. parryi*
 11. Perianth segments lance-ovate to ovate or broadly elliptic, obtuse to blunt or shallowly emarginate, entire or minutely denticulate across the tip.
 12. Perianth segments broadly elliptic to ovate, obtuse to blunt or shallowly emarginate, frequently denticulate across the apex; western Riverside county 2. *A. munzii*
 12. Perianth segments lance-ovate to ovate, obtuse, entire; central and south Coast Range 7. *A. diabolense*
8. Ovarian crest processes finely and irregularly denticulate to fimbriate or lacinate (rarely absent in var. *purdyi*).
 13. Outer pedicels of the infructescence elongating and curved upward, forming a ±flattopped inflorescence 5. *A. parryi*
 13. Pedicels of the infructescence ca =, straight.
 14. Perianth segments dark rose-purple 6a. *A. fimbriatum* var. *fimbriatum*
 14. Perianth segments white to lavender with darker midveins.
 15. Perianth segments lanceolate to lance-ovate.
 16. Scape 10–37 cm tall; ovarian crests finely dentate to lacinate or, rarely, absent; E. Lake and adjacent Colusa and Napa counties 6b. *A. fimbriatum* var. *purdyi*
 16. Scape 5–25 cm tall; ovarian crest processes finely denticulate to deeply lacinate, sometimes with additional outgrowths around their bases; Mojave Desert 6c. *A. fimbriatum* var. *mojavense*
 15. Perianth segments lance-ovate to nearly round.
 17. Perianth segments broadly ovate to nearly round, spreading from the base; Tuolumne Co. [A. tuolumnense]
 17. Perianth segments lance-ovate to ovate, obtuse, erect; central and south Coast Range 7. *A. diabolense*
1. **Allium denticulatum** (Ownbey ex Traub) McNeal, stat. et comb. nov. *Allium fimbriatum* S. Watson var. *denticulatum* Ownbey ex Traub, Pl. Life 28:64. 1972.—TYPE: U.S.A., California, Kern Co., sandy open flats 15.5 km N of Ricardo, 5 May 1932, *Munz 12461* (holotype UC!; isotypes: MO! POM!).

Bulbs ovoid to ±subglobose, 10–14 mm, outer coats reddish brown, inner coats pale brown to white, bulb coat reticulation none or with two or three rows of vertically oriented cells just above the roots; scape 5–18 cm, narrowing toward the base, becoming nearly filamentous and easily broken; leaf 1.5–2 times the

scape; umbel 5–30 flowered; pedicels 5–20 mm; straight, erect to spreading; perianth segments 9–17 mm, rose-purple, lanceolate, acute, plane, erect, \pm flaring at the tip, the inner, at least, minutely denticulate; ovarian crests entire, emarginate, or with the margins minutely papillose, ovary surface papillose between the processes, stigma trifid, spreading or reflexed (Fig. 1–3). Chromosome number $n = 7$.

DISTRIBUTION (Fig. 17): Eastern Kern Co. and north-central Riverside Co., California. Also known from single collections near Granite Well in eastern San Bernardino Co. and Mt. Pinos in western Kern Co. Sandy soils on desert slopes, from 900 to 2500 m. Flowering late April to early June.

Allium denticulatum is similar to *A. fimbriatum* var. *fimbriatum* in habit and flower color. It differs in its denticulate perianth segments and its entire, emarginate or papillose margined rather than fimbriate or laciniate crest processes. It is also similar to *A. fimbriatum* var. *mohavense* in habit and the papillae on the ovary surface between the crests, but differs in flower color and again in its denticulate perianth segments and the margins of the crest processes. Its geographic distribution, while contiguous to those of *A. fimbriatum* vars. *fimbriatum* and *mohavense*, apparently does not overlap with either taxon.

Representative specimens.—U.S.A., California, Kern Co.: Piute Mt., 5 km SE of Bodfish, Benson 4397 (POM); Kelso Valley between hwy. 6 [now hwy. 14] and 178, Bucklow 5 (RSA); hwy. 6, 13 km SW of Freeman Jct. [hwy. 178], Everett & Balls 23263 (RSA); summit flats, Mt. Pinos, Ewan 7781 (JEPS); Cedar Creek, near mouth of Fulton Creek, Farnsworth 584 (CAS); foot of Soledad Mt. near Mojave, I. M. Johnson 2251 (JEPS, POM, UC, US); hillsides above hwy. 178, 5 km E of Walker Pass, McNeal 2532 (CPH, NY); stony slopes above Erskin Creek, Purpus 5332 (GH, MO, UC, US); E fork of Red Rock Canyon, Twisselmann 3505 (CAS).—San Bernardino Co.: 5 km N of Granite Well, I. M. Johnson 2801 (DS, POM, UC).—Riverside Co.: Lost Horse Canyon, Clary 1590 (JEPS); Quail Mt., Joshua Tree National Monument, 25 April 1941 Schenck s.n. (RSA).

2. ***Allium munzii*** (Ownbey ex Traub) McNeal, stat. et comb. nov. *Allium fimbriatum* var. *munzii* Ownbey ex Traub, Pl. Life 28:64. 1972.—**TYPE:** U.S.A., California, Riverside Co.: dry heavy clay soil on a gentle slope 5.5 km south of Glen Ivy, 29 April 1922, Munz 5051 (holotype: POM!; isotype: DS!).

Bulbs ovoid to subglobose, 10–15 mm, outer coats reddish brown, inner coats lighter brown, bulb coat reticulation none or with 2–3 rows of vertically oriented cells just above the roots; scape 15–35 cm, not much narrowed toward base, firmly attached to bulb; leaf \pm 1.5 times the scape; umbels 10–35 flowered; pedicels 7–12 mm, straight, erect to spreading; perianth segments 6–8 mm, white or with pink midveins, older flowers becoming red, broadly elliptic to ovate, obtuse to blunt or shallowly emarginate, erect, straight, entire or the inner minutely denticulate across the tip; ovarian crest processes finely and irregularly dentate, stigma trifid, erect or spreading (Fig. 4, 5). Chromosome number $n = 7$.

DISTRIBUTION (Fig. 17): Slopes around Temescal Valley, western Riverside Co., California, and reported by Steve Boyd (pers. comm.) from Skunk Hollow and Bachelor Mt. near Skinner Lake in Perris Basin. Heavy, non-serpentine clay soils, grassy openings in coastal sage scrub, from 300 to 950 m. Flowering April to mid-May.

Allium munzii is distinctive among members of the *A. fimbriatum* complex in its elliptic to broadly ovate, generally obtuse perianth segments. It differs further from *A. fimbriatum* in its flower color and its finely and irregularly dentate ovarian

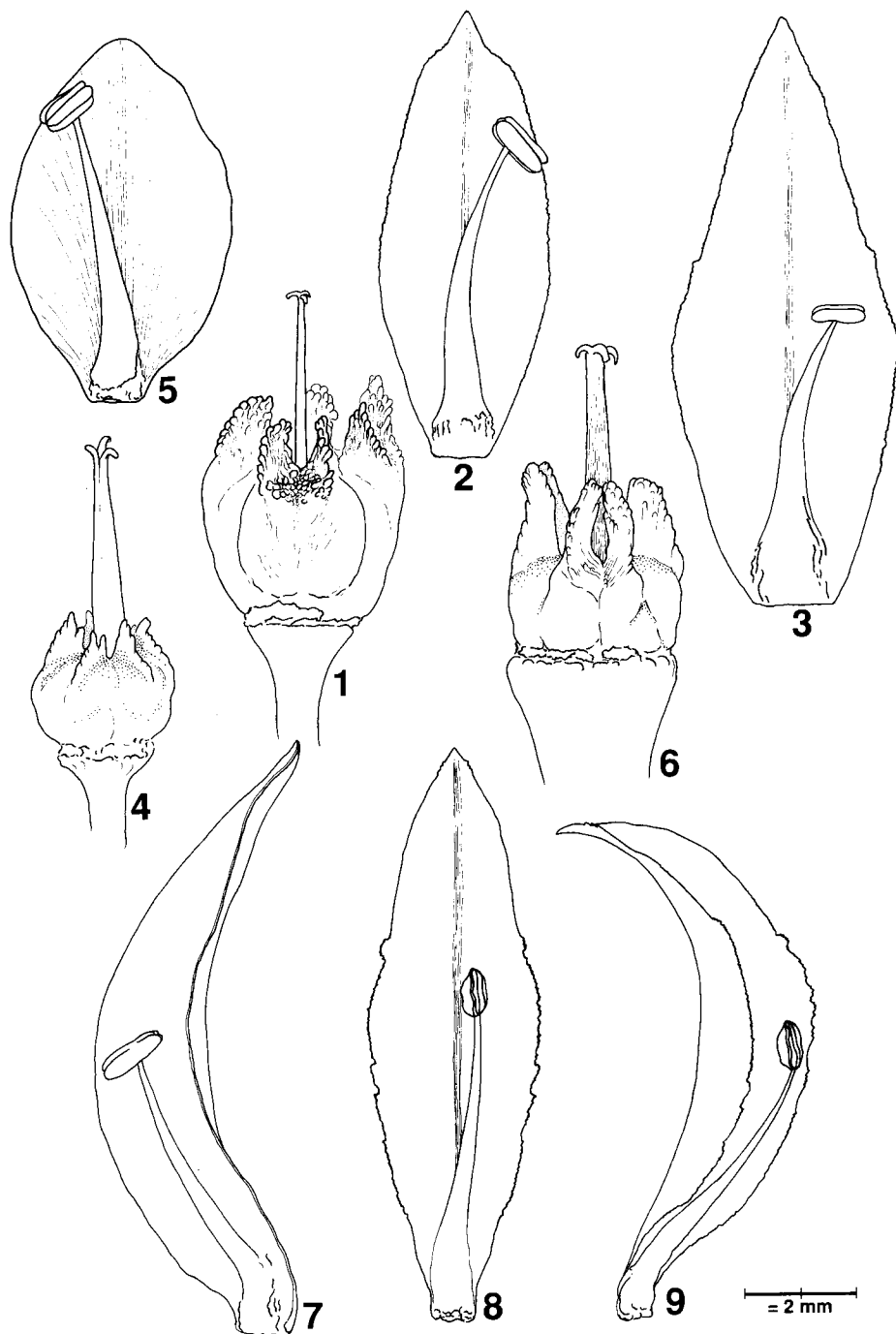


Fig. 1-9. Floral variation in *Allium*.—1-3. *A. denticulatum*; 4-5. *A. munzii*; 6-9. *A. abramsii*.—1, 4, 6: ovary; 2, 5, 8, 9: inner perianth segment; 3, 7: outer perianth segment; 7, 9: profile views.

crest processes. Its distribution, while contiguous with that of *A. fimbriatum* and *A. parryi*, does not overlap with either of these taxa.

Representative specimens.—U.S.A., California, Riverside Co.: Gavilan Peak, *Clokey et al.* 4621 (CAS, CPH, MO, NY, UC, US, WS); 5 km S of Glen Ivy, *Munz* 5051 (DS, POM); Temescal Canyon, *Boyd* 1642 (CPH, RSA); Murrieta Hot Springs, *Boyd* 1798 (CPH, RSA).

3. ***Allium abramsii*** (Ownbey ex Traub) McNeal, stat. et comb. nov. *Allium fimbriatum* var. *abramsii* Ownbey ex Traub, Pl. Life 28:64. 1972.—TYPE U.S.A., California, Fresno Co., Pine Ridge, 1400 m, 15–25 June 1900, *Hall & Chandler* 201 (holotype: DS!; isotypes: MO! NY! UC! US!).

Bulbs ovoid to subglobose, 10–15 mm, outer brown to gray, inner coats white to pink, bulb coat reticulation none or with obscure quadrate markings, usually with 2–3 rows of obvious vertically oriented cells just above the roots; scape 5–15 cm, not narrowed toward base, firmly attached to bulb; leaf 2–3 times the scape; umbels 6–40 flowered, pedicels 6–15 mm, straight, erect to spreading; perianth segments 8–15 mm, rose-purple, linear to lanceolate, the outer longer and broader than the inner, \pm strongly spreading, reflexed in the outer $\frac{1}{3}$, the inner erose-denticulate, at least in the proximal half, often crisped, the outer entire to minutely denticulate; ovarian crest processes usually entire, sometimes emarginate or minutely denticulate on the margins, stigma trifid, spreading (Fig. 6–9). Chromosome number $n = 7$.

DISTRIBUTION (Fig. 17): East-central Madera Co. to central Tulare Co., California. Disintegrated granite on the western slope of the Sierra Nevada, from 900 to 3000 m. Flowering mid-May to mid-July.

Allium abramsii is a very distinctive species, differing from *A. fimbriatum* in its brown to gray outer bulb coats and white to light pink inner coats, its reflexed somewhat erose perianth segments with the inner sometimes crisped, and its ovarian crest processes which are usually entire or nearly so. Two populations are known in Tulare Co. near the northernmost population of *A. parryi*, but it is otherwise geographically distant from other members of the *A. sanbornii* alliance.

Ownbey's report (in Munz and Keck 1959) of reticulate outer bulb coats was based on a specimen [*M. Baker* 4406a (UC!)] from Tulare Co. that consists of scapes, leaves, and flowers of *A. abramsii* with no attached bulbs and separate bulbs that Baker apparently dug up in the same location. The bulbs belong to *A. obtusum* Lemmon var. *obtusum*, a species with a distinctive bulb coat reticulation pattern (Mortola and McNeal 1985).

Representative specimens.—U.S.A., California, Fresno Co.: Jose Basin, *Bacigalupi et al.* 7117 (UC); 2 km W of Alder Springs, *Barneby & Howell* 11442 (WS); summit, Toll House Grade, 28 May 1903, *Congdon s.n.* (MO); Mono Hot Springs, *Ferguson s.n.* (JEPS); Upper Dinkey Creek, *Morton* 2851, (US); Florence Lake, *Raven* 4250 (CAS); Pine Ridge, *Hall & Chandler* 201 (DS, MO, NY, UC, US); Upper Dinkey Creek, *Morton* 2815 (US).—Madera Co.: near Whiskey Creek, 2 km NW of Ellis Meadow, *Constance* 2389 (GH, NY, UC, WS); near Bass Lake, *Raven s.n.* (CAS).—Tulare Co.: Mineral King, *M. Baker* 4406a (UC); Coffee Pot Camp Ridge, vicinity of Homer's Nose, *Dudley* 1777 (DS); N Fork Kaweah River, T.15S, R.29E, Sec. 5, *Shevock* 7857 (CPH); off county road M-220 at Slick Rock, *Shevock* 7486 (CPH); Lloyd Creek ca. 1 km SE of Soda Spring, *C. N. Smith* 1324, (JEPS).

4. ***Allium sharsmithae*** (Ownbey ex Traub) McNeal, stat. et comb. nov. *Allium fimbriatum* var. *sharsmithae* Ownbey ex Traub, Pl. Life 28:64. 1972.—TYPE U.S.A.; California, Stanislaus Co., near head of Arroyo del Puerto, Red Mts.,

450 m, 19 May 1935, *H. K. Sharsmith 3143* (holotype: WS! [Accession #43459]; isotypes: UC! US! WS!).

Bulbs ovoid to subglobose 10–18 mm, outer coats reddish brown, inner coats lighter brown, bulb coat reticulation none or with 2–3 rows of vertically oriented cells just above the roots; scape 4–17 cm, not narrowed toward base, firmly attached to bulb; leaf \pm 2 times the scape; umbels 5–50 flowered; pedicels 6–19 mm, straight, erect to spreading; perianth segments 10–18 mm, dark red-purple, lance-linear to narrowly elliptic, acute to attenuate, plane, erect, flaring at the tip, entire; ovarian crest processes entire to shallowly emarginate, papillate on the surface, particularly near the tips, stigma trifid, reflexed (Fig. 10, 11). Chromosome number $n = 7$.

DISTRIBUTION (Fig. 17): Mt. Hamilton Range in Alameda, Stanislaus, and Santa Clara counties. Restricted to serpentine soils from 450 to 1150 m. Flowering late April to mid-May.

Allium sharsmithae is a highly restricted serpentine endemic that differs from *A. fimbriatum* in its generally larger flower size and its distinctive papillate crest processes. The papillae are most easily seen in fresh material or in flowers that have been reconstituted in hot water. *Allium sharsmithae* replaces *A. fimbriatum* in the Mt. Hamilton range where its distribution overlaps *A. diabolense*, from which it differs in its flower size, color, and papillate crest processes.

Representative specimens.—U.S.A., California, Alameda Co.: Cedar Mt., *Westgard 117* (UC).—Santa Clara Co.: Red Mt., *Elmer 4633* (CAS, DS, MO, NY, UC, US).—Stanislaus Co.: Del Puerto Canyon, 42 km W of Patterson, *Hoffman 2797* (WS); Del Puerto Canyon Rd., 35 km W of hwy. I-5, *McNeal 2024* (CPH, NY); Adobe Creek Canyon, Red Mts., Mt. Hamilton Range, *H. K. Sharsmith 3573* (DS, UC, US, WS).

5. **ALLIUM PARRYI** S. Watson, Proc. Amer. Acad. Arts 14:231. 1879. *Allium fimbriatum* ssp. *parryi* Traub, Pl. Life 23:110. 1967.—**TYPE:** U.S.A., California, San Bernardino Co., Bear Valley, 1876, *Parry 390* (holotype: GH!; isotypes: MO! NY!).

Bulbs ovoid to subglobose, 8–14 mm, outer coats reddish-brown, inner coats lighter brown, bulb coat reticulation none or with 2–3 rows of vertically oriented cells just above the roots; scape 5–20 cm, not narrowed toward the base, firmly attached to bulb; leaf \pm 1.5 times the scape; umbel 8–50 flowered; pedicels 6–20 mm, in the infructescence the outer longer and curving upward; perianth segments 6–9 mm, white or with pink midveins, older flowers becoming red; lanceolate to lance-ovate, acute to attenuate, entire, plane, straight or flared at the tip; ovarian crest processes entire or emarginate, sometimes finely and irregularly dentate, stigma trifid, spreading or reflexed. Chromosome number $n = 7$.

DISTRIBUTION (Fig. 17): Scattered locations in the southern Sierra Nevada of Tulare Co., California and in the San Bernardino, San Jacinto and Cuyamaca mountain ranges of Southern California. It is also known from one collection in northern Baja California (not on map). Sandy or more commonly clay soils from 900 to 2150 m. Flowering late April to mid-July.

Allium parryi differs from *A. fimbriatum* in its long, distinctively curved fruiting pedicels that result in an almost flat-topped umbel in some plants. It also differs in having entire or nearly entire crest processes. The flower color makes it resemble

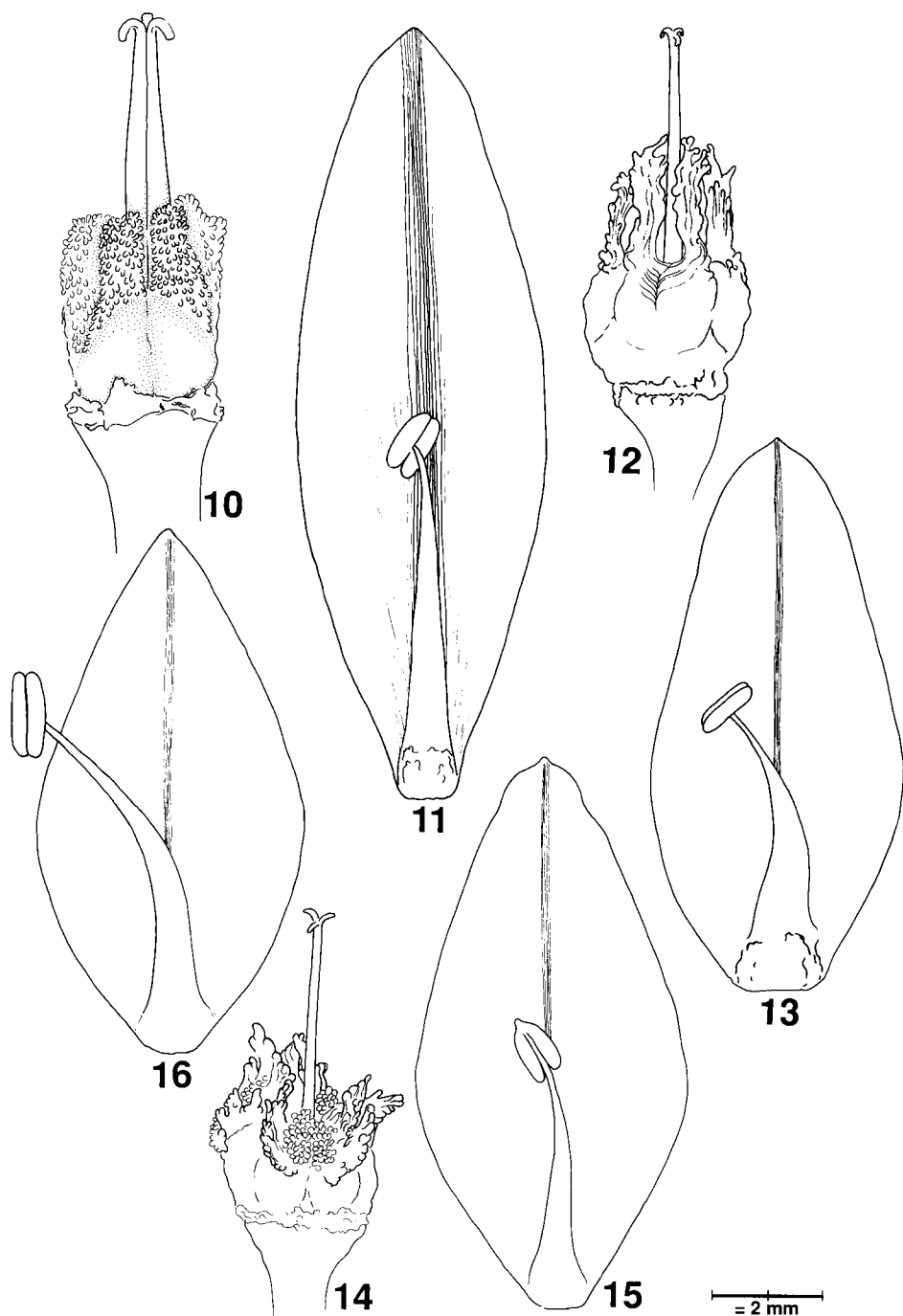


Fig. 10-16. Floral variation in *Allium*.—10-11. *A. sharsmithae*; 12-13. *A. fimbriatum* var. *fimbriatum*; 14-16. *A. fimbriatum* var. *mohavense*.—10, 12, 14: ovary; 11, 13, 16: inner perianth segment; 15: outer perianth segment.

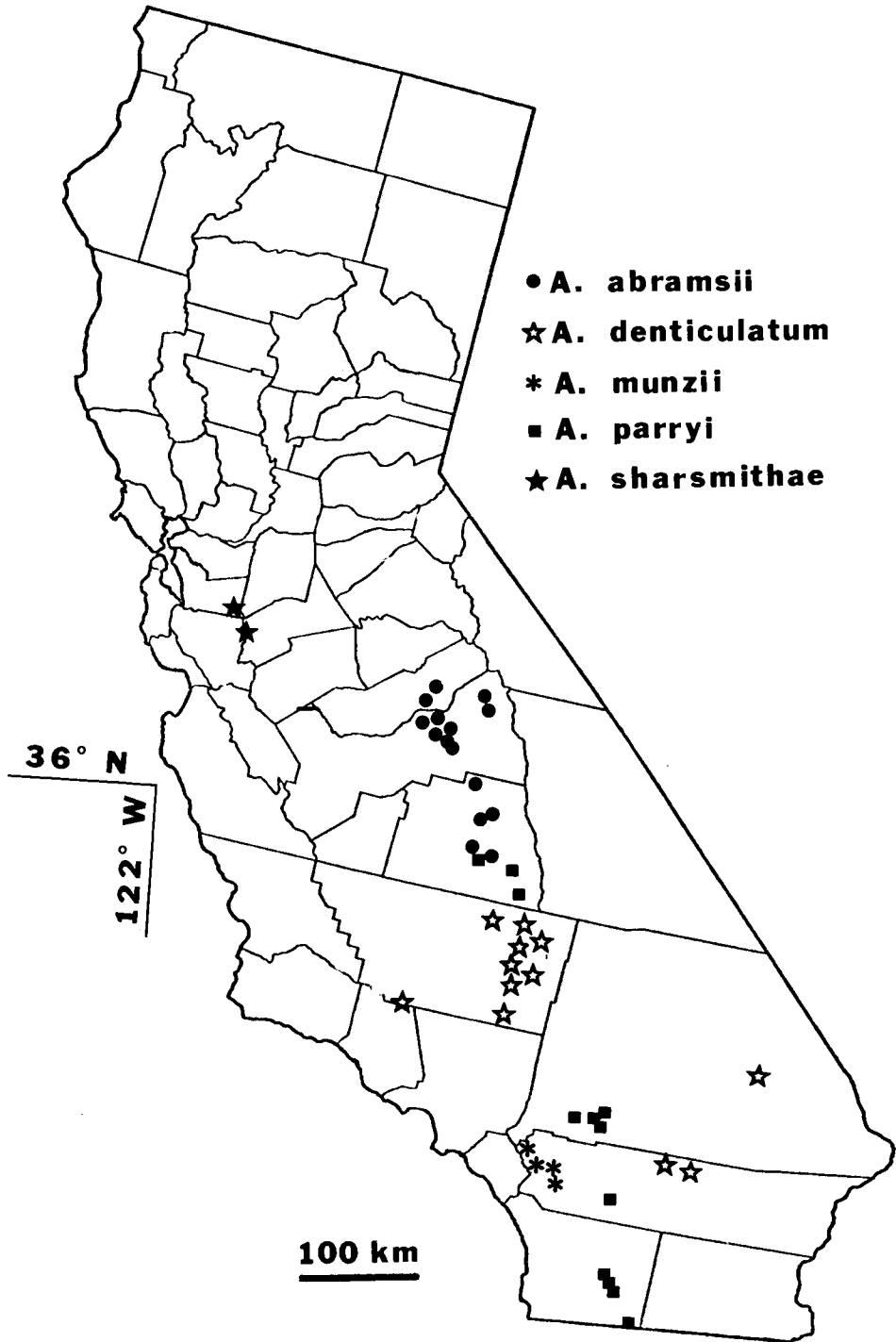


Fig. 17. Distribution of *Allium abramsii*, *A. denticulatum*, *A. munzii*, *A. parryi*, and *A. sharsmithae*.

A. munzii of the south coast and *A. diabolense* of the central and south coast ranges, from which it differs in the shape of its perianth segments and again in its curved pedicels.

Representative specimens.—U.S.A., California, Riverside Co.: Morris Ranch Rd., 4 km E of hwy. 74 at Kenworthy Ranger Station, *McNeal* 2545 (CPH, NY).—San Bernardino Co.: rocky flat N of Baldwin Lake, *Bacigalupi et al.* 4249 (JEPS); 27 km S of Victorville, *Jaeger s.n.* (POM); rim of the World Dr. just E of Running Springs, *Ownbey & Ownbey* 2977 (WS); Arraster Flat, *Peirson* 9022 (RSA).—San Diego Co.: near Cuyamaca Lake, 24 June 1903, *Abrams* 3873 (CAS, DS, GH, NY, MO, POM, UC, US, WS); near Julian, *Fosberg* 8284 (POM); 9 km E of Jacumba, *Munz* 8081 (POM); head of Vallecito Canyon, Laguna Mts., *Munz* 8429 (POM).—Tulare Co.: Lloyd Rd. [USFS 22S82], ca. 1.5 km N of Peppermint Creek, *Shevock* 5936 (CPH); Dome Land Wilderness, Troy Meadows, along trail down Long Valley to the S Fork of the Kern River, T.21S, R.35E, Sec. 30, *Shevock* 7381 (CPH).—MEXICO, Baja California: Hansen's Ranch, northern Baja California, 10 July 1884, *Orcutt s.n.* (GH, US).

6. *ALLIUM FIMBRIATUM* S. Watson, Proc. Amer. Acad. Arts 14:232. 1879.—TYPE: U.S.A.; California, San Bernardino Co., Mojave River, 1876, *Palmer s.n.* (holotype : GH!).

Bulbs ovoid to \pm subglobose, 10–17 mm, outer coats red-brown, inner coats pale brown to white, bulb coat reticulation none or with two or three rows of vertically oriented cell just above the roots; scape 10–37 cm, not, or only slightly, narrowed toward the base, firmly attached to bulb; leaf 1.5–2 times the scape; umbels 6–75 flowered; pedicels 6–20 mm, straight, erect or spreading; perianth segments 6–14 mm, dark rose-purple to white, lanceolate to ovate, acute to obtuse, erect, straight or slightly flaring at the tip, entire, plane; ovarian crest processes finely dentate to deeply lacinate, rarely absent in var. *purdyi*, stigma trifid, spreading to reflexed. Chromosome number $n = 7$.

DISTRIBUTION: Lake Co., California, south in the coast ranges to San Diego Co., east across the Tehachapi Mts. to the Mojave Desert, and south to northern Baja California.

Allium fimbriatum is closely related to *A. sharsmithae*. It differs in its finely dentate or, more commonly, fimbriate or lacinate, nonpapillate crest processes and broader perianth segments. It is also close to *A. denticulatum* which has papillae on the ovary surface, but has narrower, irregularly denticulate inner perianth segments and mostly entire or papillate ovarian crest process margins.

6a. *ALLIUM FIMBRIATUM* S. Watson var. *FIMBRIATUM*

Allium fimbriatum S. Wats. var. *aboriginum* Jepson, Fl. Calif. 1:273, 1922.—TYPE: U.S.A., California, NE Lake Co., Indian Valley, 23 May 1920, *Jepson* 8995 (holotype: JEPS!).

Allium anserinum Jepson, Fl. Calif. 1:274, 1922.—TYPE: U.S.A.; California, Goose Lake Valley [see discussion], May 1894, *Austin s.n.* (holotype: JEPS!).

Scape 10–20 cm; umbel 6–35 flowered; perianth segments 9–14 mm, dark rose-purple, the tips flaring; ovarian crest processes finely and irregularly dentate to fimbriate or lacinate (Fig. 12, 13).

DISTRIBUTION (Fig. 18): California, Lake, and Napa counties, disjunct south to San Benito and Monterey counties, and from there south in the Coast and Transverse ranges to San Diego Co. with one collection from Baja California (not on map); also found along the San Joaquin Valley and desert slopes of the southern

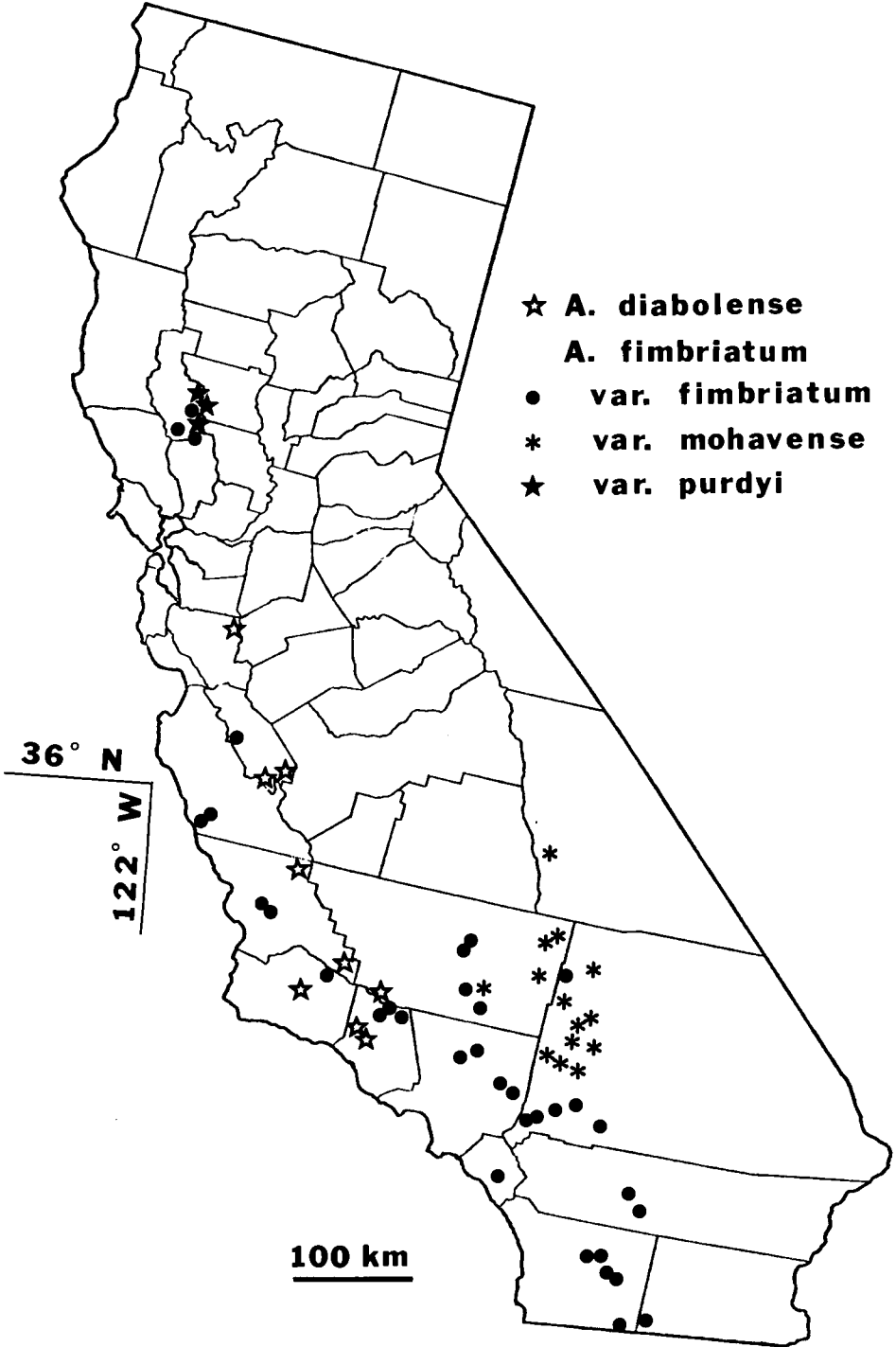


Fig. 18. Distribution of *Allium diabolense* and *A. fimbriatum* varieties *fimbriatum*, *mohavensis*, and *purdyi*.

Sierra Nevada and Tehachapi mts. and the western desert ranges of Kern and San Bernardino counties. Clayey, volcanic and serpentine soils, from 300 to 2700 m. Flowering late April through June

Jepson's var. *aboriginum* is based on the holotype from Lake Co., California, and several specimens from the "southern Sierra Nevada from Fresno Co. to Tulare Co." These latter specimens all belong to *A. abramsii* or *A. denticulatum* and differ from *A. fimbriatum* in the characters previously discussed. The holotype, on the other hand, is clearly different from the southern Sierra Nevada material and belongs to *A. fimbriatum* var. *fimbriatum*.

Jepson's *A. anserinum* is more puzzling: the holotype consists only of flowers that are dark rose-purple and have trifid stigmas and fimbriate to laciniate crest processes. As such it fits into *A. fimbriatum* var. *fimbriatum*. The label reads simply "Goose Lake Valley, R. M. Austin, May 1894." It is likely that the specimens were neither collected by Mrs. Austin nor collected in the Goose Lake Valley in Modoc County. I have been unable to locate any other Goose Lake that is in or near the range of the species and speculate that this is one of those cases where herbarium labels have been mixed before specimens were mounted.

Representative specimens.—U.S.A., California, Imperial Co.: Mt. Springs, Colorado Desert, 1899, *Orcutt s.n.* (MO).—Lake Co.: between Middletown and Lower Lake, *Mason 5258* (UC); floodplain of Stanton Creek, Little Indian Valley, T.15N, R.6W, Sec. 9, *Sanford 357* (CPH).—Kern Co.: hills between Rosamond and Mojave, *Abrams 11766* (DS); Tehachapi Pass, *Benson 3493* (POM, UC!); Hot Springs, *Brandegee s.n.* (UC); Walker's Basin, *Brandegee s.n.* (UC).—Los Angeles Co.: near Palmdale, *Eastwood & Howell 3960* (CAS, POM); San Gabriel Mts. above Little Rock, *Kamb 962* (UC); 5 mi SSE of Neenach, *Gifford 701* (RSA, UC); 4 km NW of Mile High above Shoemaker Canyon, *Tilforth & Dourley 809* (RSA).—Monterey Co.: Ring City Rd. between San Antonio Mission and Jolon, *Hardham 10369* (CAS); Los Burros trail, Santa Lucia Mts., 1–12 May 1898, *Eastwood s.n.* (DS, NY, US).—Napa Co.: 1 km NW of Knoxville, T.16N, R.6W, *Schreiber 2507* (UC).—Riverside Co.: Pinyon Flats, San Jacinto Mts., *Raven 12984* (CAS, GH, WS); Van Deventers Ranch, *Jepson & Hall 1461* (JEPS).—San Bernardino Co.: Horsethief Canyon, *Clokey & Anderson 6744* (DS, LAM, MO, NY, POM, UC, WS); summit, Cajon Pass, *Parish & Parish 1343* (DS, GH, MO, NY, UC, US); near Johannesburg, *Hall 6876* (UC); Arraster Creek, *Peirson 405* (JEPS); Grapevine Canyon Rd., ca. 7 air km S of Fifteenmile Pt., *Thorne et al. 52991* (RSA).—San Benito Co.: E slope of Rim Trail, Pinnacles National Monument, *Burgess 139* (UC).—San Diego Co.: Jacumba Hot Springs, *Abrams 3638* (DS, NY); San Felipe, May 1890, *Brandegee s.n.* (UC); Mason Valley, 3 May 1948, *Higgins & Harbison s.n.* (RSA); Vallecito, *Jepson 8537* (JEPS); Banner, 19 April 1906, *Jones s.n.* (POM).—San Luis Obispo Co.: Rinconada Mine S of Santa Margarita, *Hoover 8521* (CAS, UC); rd. to Hi Mt. from Pozo-Arroyo Grande summit, *Hoover 8774* (CAS, UC).—Santa Barbara Co.: Sierra Madre Mts. between Montgomery Potrero and McPherson Pk., *Blakley 3429-A* (CAS).—Ventura Co.: near summit, Frazier Mt., *Ownbey & Ownbey 2985* (WS); Cuddy's Canyon, Mt. Pinos, *Munz 7057a* (POM); summit, Mt. Pinos, *Twisselmann 3798* (CAS); summit, Sawmill Mt., *Twisselmann 6335* (CAS).—MEXICO, Baja California: Laguna Hansen Rd., 100 km SE of Tecate, *Peirson 5875* (RSA).

- 6b. *ALLIUM FIMBRIATUM* S. Watson var. **purdyi** (Eastwood) Ownbey ex McNeal stat. et comb. nov. *Allium purdyi* Eastwood, Leaflet. W. Bot. 2:110. 1938. *A. fimbriatum* ssp. *purdyi* (Eastwood) Traub, Pl. Life 23:110. 1967.—TYPE: U.S.A., California, Lake and Colusa counties, county line E of Lower Lake, May 1933, *Purdy s.n.* (holotype: CAS!).

Scape 10–37 cm, stout; umbels 20–75 flowered; perianth segments 8–12 mm, white to lavender with darker midveins; ovarian crest processes finely dentate to laciniate, rarely absent.

DISTRIBUTION (Fig. 18): Northern Napa to eastern Lake and adjacent Colusa counties. Serpentine soil from 300 to 600 m. Flowering late April through May.

Allium fimbriatum var. *purdyi* differs from var. *fimbriatum* in its generally more robust habit, its white to lavender flowers, and in the fact that individual specimens in populations may lack the ovarian crests entirely. I would have suggested that this variety deserved recognition as a species except for specimens, including the type, which are clearly intermediate. There seems to be an altitudinal gradient between the two varieties. Specimens from the summit on highway 20 at the border between Lake and Colusa counties and areas along the ridges to the north and south are somewhat smaller and have lavender flowers, thus resembling var. *fimbriatum*. Specimens from lower elevations along Bear Creek about 4 km to the east are more robust and have white flowers.

Representative specimens.—U.S.A., California, Colusa Co.: Hwy. 20 at the Lake Co. line, *Heller 15579* (RSA, MO, NY, UC, US, WS); above hwy. 20, 1.6 km W of hwy. 16, *McNeal 2028* (CPH, NY); Bear Valley Road, 1.5 km NW of hwy. 20, *McNeal 2317* (CPH).—Lake Co.: Hill 1030, 4.8 km NE of Middletown, *Bacigalupi & A. Holmgren 3194* (JEPS, UC); 9 km E of Hough's Springs, *Heller 13148* (CAS, DS, GH, MO, UC, US); Little Indian Valley, T.15N, R.6W, Sec. 9, *Sanford 357* (CPH, LAM).—Napa Co.: near summit of ridge W of Knoxville, 3 *Heller 16127* (UC); Pope Creek Canyon, 14 km NW of Monticello, *J. T. Howell 6131* (CAS).

- 6c. *ALLIUM FIMBRIATUM* S. Watson var. *MOHAVENSE* Jepson, Fl. Calif. 1:273. 1922. *A. mohavense* Tidestrom, Proc. Biol. Soc. Wash. 48:39. 1935. *A. fimbriatum* ssp. *mohavense* (Jepson) Traub, Pl. Life 23:110. 1967.—TYPE U.S.A., California, San Bernardino Co., Calico Mts., 4 May 1913, *Jepson 5403* (holotype: JEPS!).

Scape 10–25 cm; umbel 12–60 flowered; perianth segments 8–14 mm, white, pink or light lavender; ovarian crest processes deeply lacinate with papillae and sometimes larger outgrowths on the ovary surface between the processes (Fig. 14–16).

DISTRIBUTION (Fig. 18): In the western Mojave Desert, California, from the southern Owens Valley, Inyo Co. to the base of the San Bernardino Mts., San Bernardino Co. Sandy soils on desert slopes from 750 to 1400 m. Flowering mid-April to June.

Allium fimbriatum var. *mohavense* is restricted to the floor and lower mountain slopes of the western Mojave Desert. It is distinct from var. *fimbriatum* except in an area along the north base of the San Bernardino Mountains where the distribution of the two is contiguous and where specimens show intermediate characteristics. These specimens have lavender to purple flowers and ovarian crest processes that are dentate to somewhat lacinate, without any additional outgrowths from the ovary surface. It may be that these specimens belong to var. *fimbriatum*. However, by placing them here their intermediate nature and the close relationship between the two varieties is accented.

Representative specimens.—U.S.A., California, Inyo Co.: Hwy. 395, 10 km. S of hwy. 190 in Olanche, *McNeal 3062* (CPH). Kern Co.: Red Rock Canyon, *Benson 3389* (DS, POM); Tehachapi Pass, *Benson 3491* (DS); near jct. of hwy. 14 and Inyokern Rd., W side of Indian Wells Valley, *Meng 275* (CAS); 9 km N of Ricardo, *Munz 12458* (MO, POM, UC).—San Bernardino Co.: Ord Mt., *Beal s.n.* (JEPS); benches near Victorville, *Hall 6767* (UC); 2 km S of Pilot Knob, *I. M. Johnson 2801* (POM); Kramer Jct., *Jones s.n.* (CAS, CPH, POM); Adelanto, *Jones s.n.* (POM); ridge above Stoddard Well, *McNeal 2314* (CPH); ca. 17.5 km E of Victorville, *Munz 12436* (MO, POM, UC); 24 km NE of Barstow, *S. B. Parish 9712* (DS).

7. *Allium diabolense* (Ownbey ex Traub) McNeal, stat. et comb. nov. *Allium fimbriatum* var. *diabolense* Ownbey ex Traub, Pl. Life 28:64. 1972.—TYPE: U.S.A., California, Stanislaus Co., near head of Arroyo del Puerto, Red Mts., 550 m, 18 May 1925, *H. Sharsmith* 3117 (holotype: WS!; isotypes DS! NY! UC! US!).

Bulbs ovoid to subglobose, 10–16 mm, outer coats red-brown, inner coats pale brown to white, bulb coat reticulation none or with two or three rows of vertically oriented cells just above the roots; scape 7–20 cm, not or only slightly narrowed toward the base, firmly attached to bulb; leaf 1.5–3 times the scape; umbels 10–50 flowered, pedicels 7–20 mm, straight, erect to spreading; perianth segments 6–10 mm, white with pink midveins and sometimes pink tips, lance-ovate to ovate, obtuse, erect, plane, entire; ovarian crest processes emarginate to lacinate, rarely entire, stigma trifid, spreading to reflexed. Chromosome number $n = 7$.

DISTRIBUTION (Fig. 18): Central and South Coast ranges of California from Alameda Co. to Santa Barbara and Ventura counties. Apparently restricted to serpentine soils from 500 to 1500 m. Flowering early May to mid-June.

Allium diabolense differs from *A. fimbriatum* var. *fimbriatum* in its generally smaller flowers and broader, obtuse, white perianth segments. While its flower color resembles that of other taxa described here, it otherwise seems most closely related to *A. munzii*, from which it differs in its longer leaves, narrower perianth segments, and generally more dissected crest processes.

Representative specimens.—U.S.A., California, Alameda Co.: near head of Arroyo del Puerto, Mt. Hamilton Range, *Mason s.n.* (UC, WS).—San Benito Co.: summit of the dirt rd. from New Idria Mine to Clear Creek, 16.5 km E of Coalinga Rd., *McNeal* 3710 (CPH); summit of San Benito Mt., near communication tower, *Griffin* 3530 (JEPS).—Kern Co.: head of Quatal Canyon, hill just N of Toad Spring, *Twisselmann* 7200 (CAS, WS).—San Luis Obispo Co.: Caliente Mt., *Hoover* 8219 (CAS, UC); Palo Prieta Canyon, *Twisselmann* 15221 (CAS).—Santa Barbara Co.: Cachuma Guard Station, Figueroa Mt. Rd., 1.3 km W of Munch Canyon Trail, *Lewis s.n.* (WS).—Ventura Co.: Sanstone [sic] Camp, Upper Sespe Creek, *Blakley* 6006 (CAS, JEPS, RSA); Rose Lake, *Hardham* 4378 (CAS, RSA).

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APPENDIX

Meiotic chromosome numbers of the *Allium fimbriatum* complex. All collections are from California, U.S.A. Counts are by the author unless otherwise indicated. Voucher specimens are deposited at CPH unless otherwise indicated.

- A. abramsii*, $n = 7$, Fresno Co., granite outcrop beside Alder Springs Rd., 3.0 km N of hwy. 168, *McNeal* 3707.
- A. denticulatum*, $n = 7$, Kern Co., hillsides above Piute Mt. Rd., 1.5 km E of the Bodfish-Havilah rd., *McNeal* 2527; hillsides above hwy. 178, 5.0 km E of Walker Pass, *McNeal* 2532.
- A. diabolense*, $n = 7$, San Benito Co., summit of Clear Creek Rd. above New Idria, *McNeal* 3710.
- A. fimbriatum*
 var. *fimbriatum*, $n = 7$, Ventura Co., near summit of Frazier Mt., T.8N, R.20W, Sec. 13, *Ownbey & Ownbey* 2985 (WS)—count by Aase in ms.
 var. *mojavense*, $n = 7$, San Bernardino Co., ridgetop above Stoddard Wells Rd., just E of Stoddard Wells, *McNeal* 2633.
 var. *purdyi*, $n = 7$, Colusa Co., above hwy. 20 at the Lake Co. line, *McNeal* 1303.
- A. munzii*, $n = 7$, Riverside Co., Temescal Canyon, 0.2 km E of Indian Truck Trail exit from Interstate 5, T.5S, R.6W, Sec. 12, *Boyd* 1640; summit of Estelle Mt., *Boyd* 1781.
- A. parryi*, $n = 7$, San Bernardino Co., south and east of Big Bear Lake, *Ownbey & Ownbey* 2974 (WS); Rim of the World Drive just E of Running Springs, *Ownbey & Ownbey* 2977 (WS)—both counts by Aase in ms.
- A. sharsmithae*, $n = 7$, Stanislaus Co., slope above Del Puerto Canyon Rd., 35 km W of Interstate 5, *McNeal* 2024.